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BENEFICIAL AND NOXIOUS AGENTS.

BY

CHAS. S. DOLLEY, M. D., ROCHESTER, N. Y.

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BY CHAS. S. DOLLEY, M. D.

ROCHESTER, N. Y.

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[*Read before the Rochester Society of Natural Sciences.*]

Although the organisms which we are about to consider this evening have been known and studied for many years, it is only within the last decade or so that they have awakened any great interest in the scientific and popular mind. Since the promulgation of the germ theory of disease especial attention has been paid them, they have had frequently to shift their position in organic classification, and have had many true, but more false attributes laid at their door. Even at the advanced stage which science has reached to-day we are unable fully to comprehend their true relations to the various phenomena, both normal and pathological, with which we find them associated.

The popular idea of their nature is a vague one, the import of their presence being in many instances exaggerated, although often overlooked to the detriment of public and private health. After having for some time vacillated between the animal and vegetal kingdoms, they were set apart by the great German Naturalist, Hackel, in a kingdom created for their special benefit—the *Protista*. This however did not

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satisfy modern phylogenists and true to their restless character *Bacteria* again began a movement which has ended in their vegetal nature being well established. That they are plants is now the unanimous verdict of scientists, although their true position among cryptogamic plants still remains a mooted point. Cohn maintains their algal nature; though admitting a close relationship to the fungi, in their lack of Chlorophyll. Sachs seems to have solved the question by uniting the algæ and fungi in a single group the Thallophytes, in which he establishes two paralell series, one comprising forms possessing chlorophyll, the other forms destitute of it.

Accepting then their plant nature, and leaving naturalists to settle their exact phylogenitic relationships, let us proceed to the consideration of some of the more salient characteristics of these the smallest of all organisms, either animal or vegetal. Strictly speaking the term *Bacteria* signifies a little rod or staff, but bacteria vary in form from globose to linear, and may be separated into several groups or genera, according to their peculiar shape.

While the term Bacteria still stands as the popular designation of the family, it is more strictly, limited as a generic term indicating that form which is short and rod-like in appearance, i. e. *Bacterium.* That form exhibiting a round or oval contour is denoted by the term (*sphærobacterium*) *Micrococcus.*

The long stiff fibre-like form is signified by the term *Bacillus*, while that form which while long and fibre-like is at the same time flexible, is called *Spirochaete.*

Other filamentous forms may be stiff and fibre-like, but twisted like minute corkscrews, or yet merely wavy or curl-like. They are therefore designated respectfully by the terms *vibrio* or *spirillum.*

In size we have already characterized bacteria as the smallest of living organisms. This is, so far as our best lenses tell us, true: and beyond them life does not exist. Their germs or spores are undoubtedly the smallest particles into which protoplasm is capable of being divided, and still retain its bioplastic properties.

Were it not that they live in such masses their existence would probably have remained unknown. A cube the size of a pin head would contain about six hundred and thirty-three millions of rod

bacteria, and they increase with such rapidity that Cohn has calculated that the bacteria which spring from one germ, would in less than five days fill the whole world's seas completely full. Bacteria multiply both by fission and endogenous cell-formation.

An individual in the first case, after increasing somewhat in size, begins to undergo hourglass contraction, untill finally breaking in two in the middle, two individuals are set free, which in their turn undergo the same process. In the second method, the central protoplasm of the individual becomes broken up into minute spherical bodies or spores which after a time are set free and under favorable circumstances develop into organisms identical with that from which they originated. The greater proportion of bacteria are transparent, and colorless, but some forms of *Micrococci* or spherical bacteria assume the most brilliant tints, from a deep blood red to a beautiful golden yellow. These are termed the pigmentary bacteria (*Micrococci chromogenes*), and occur usually upon cooked alimentary substances, as the hard white of eggs or cooked potatoes, which have been left exposed in dark, damp places. At times the variety secreting the red pigment, has given rise to much excitement, being considered as a miraculous indication of coming calamity, of divine wrath or of "secret guilt calling for bloody atonement." The coloring material of these pigmentary bacteria is closely allied in a chemical way to the aniline dyes so largely used at the present time.

We have thus run hastily over some of the more important points in regard to the organization of bacteria. We know there are such organisms, that they assume a limited number of shapes, easily recognizable under the microscope, that they develop with the most wonderful rapidity, and that they develop in certain instances in such a manner that their presence may be known by the unaided eye.

What now is their economic value? Do they have any useful office to fill, or must we deem them but a scourge and plague, and of no direct benefit to man. Scarcely that: their importance in the economy of nature is as grand as is their power of development, and while at times we find ourselves compelled to use all the resources of medical skill to combat their influence, on the other hand we at times cultivate them most assiduously and could ill afford to have them join the ranks of extinct organisms. Before, however, taking up those points which are settled, and in which we have become convinced of

their value, let us look back into an early epoch of terrestrial history, and view the great service which scientific hypothesis has intimated may have been theirs to perform.

THE PLACE OF BACTERIA IN THE EVOLUTION OF ORGANIC FORMS.

Omne vivum ex vivo, that all life is derived from preexisting life, is a motto which has come to be almost universally accepted among modern biologists. Now geologists have as universally decided that at an early period of the earth's history, life did not and could not exist. Had protoplasm been rained upon the earth at that period, in storms more terrible than those which later on gave Noah an opportunity of assisting in the survival of some of the most unfit, as well as of the fittest creatures; it would long before even reaching the proximity of what is now our atmosphere have been broken up by the fervid heat into its ultimate gases, to be again diffused throughout the universe. Later on we are informed that the molten mass cooled down to such an extent, that after a condensation of the vapors, waters appeared. Soon after this we have described to us, a period in which plant and animal life literally teems in the damp tropical atmosphere, but geologists fail to inform us from whence all this life comes. The exact scientist stops here—for lack of evidence; but those with minds more imaginative step in, and fill up the period between the chaotic stage and that in which the world is suddenly found prolific with life, on the one hand by accepting Hebrew traditions, or or the other by claiming, that in the process of cooling certain gases and bases of a high rate of molecular motion united to form compounds, in which the combined molecular activity was such as constitutes life. At this point they resume the more settled paths of science and allow these spontaneously evolved germs, these "aesthetophores,"* to develop according to the admitted laws of evolution. Bnt how about our motto *omne vivum ex vivo*. This may not stand, if we accept either the hypothesis of Hebrew tradition on the one hand, or that of Bastian and Pouchet on the other. We have but one alternative, and that is to frame an hypothesis that will introduce life to the world without creating it *de novo* either by the spontaneous combinations of chemical equivalents, or by one or more direct acts of the Infinite. We must have life from preexisting life, we know there could have been none on this globe, hence we conclude it must have come from without, from some planet which was at that time capable of and in the act of sustaining life.

* E. D. Cope. "Evolution Number" of *American Naturalist*. May, 1882.

We have much evidence that myriads of minute organisms are carried about in the air. Tyndall confirms this by his experiments.* He says:—"The air of our London rooms is loaded with organic dust. Nor is the country air free from its presence. How ever ordinary daylight may permit it to disguise itself, a sufficiently powerful beam causes dust suspended in air to appear almost as a semi-solid. Nobody could, in the first instance, without repugnance, place the mouth at the illuminated focus of the electric beam and inhale the thickly massed dust revealed there. Nor is the repugnance abolished by the reflection that although we do not see the floating particles, we are taking them into our lungs every hour and minute of our lives."

Aeronauts have collected, with properly prepared apparatus, great numbers of bacteria and other vegetable spores, at the highest altitudes —and it is claimed that the minute circular or spherical siliceous bodies found in atmospheric dust, are fossils, that "they are the micrococci of another age."†

The sun very frequently reveals to the aerial voyager great quantities of spider-web filaments scintillating in the rarified air of his highest journey. Rome has been showered with the sands of Sahara, and France with South American diatoms. These facts, together with certain cosmical appearances of light, lead as to suppose the existence of a world dust, and it is easy to believe that many organisms or spores may be carried by ascending currents of air, so far that, losing the attraction of this planet, they float about in space, until again attracted towards our own or some other sphere, when they may or may not, find conditions favorable to further development.

Analogy alone, would lead us to believe that there are or have been, other planets capable of sustaining life, and now this belief is receiving confirmation in the shape of discoveries of meteoric fossil organisms the organic character of which, though at first disputed, has recently been corroborated by several eminent scientists. This, then, may have been the first capacity in which bacteria evinced their power on earth, and these forms which we may every day see under our object-glasses, are in great probability, together with ourselves and all other animal

* In a discourse on "Dust and Disease"—*Fragments of Science*, John Tyndall. Also, M. Pierre Miguel's articles in Brebissonia on "Organized Dust of the Atmosphere."

† Dr. T. L. Phipson, T. C. S., "On the Grains of Silica and Micrococci in the atmosphere, *Scientific American Supplement*, No. 272.

and vegetal life of to-day, the direct and indirect descendants of these pioneer germs of terrestrial life. Let us now notice some of the more ordinary methods in which these potent little particles act beneficially.

THE AGENCY OF BACTERIA IN MATERIAL METAMORPHOSIS.

In the matter of nutrition :—we find the materials of both organic and inorganic nature called into play. The great bulk of the plant world derives its nourishment from inorganic matter, the plants taking the crude materials as they are furnished in the salts of the soil, elaborates them in its cells and forms from them its cellulose, its starch, its chlorophyll and its diastase. On the other hand animal life depends in as great a degree upon materials which have been already elaborated by vegetal chemism. It depends mainly upon the plant's starch and gluten, in one shape or another. Either taking them direct, or in the case of carnivorous animals, simply taking the results of their assimilation by others. Now suppose this double drain upon inorganic nature were to continue with no return. How long would it be possible for life to exist? Our farmers have learned, many of them rather late, that they cannot demand food from the soil, without rendering some return. They must, in the shape of fertilizers of one kind or another, begin paying back a tribute of which their ancestors thought to defraud the earth which gave them bread.

What are these fertilizers? No more than materials which have completed what we may call the circle of nutrition. Materials have been taken from the earth in the first place to form plant tissue, this in its turn, has been appropriated by the animal economy and these very animals yield themselves up at last, in the shape of super-phosphates, etc., to the soil, which takes back its own.

This seems simple enough, but it is not spontaneous. We know of beef being sent from Australia to England and reaching that country as fresh as though but just from the English *abattoirs*. We wish fresh fruits out of season and we have only to step to our cup-boards or to the store and to obtain that, which retains all the flavor of freshly cooked fruit. How is this, simply because we have been able to exclude from the meat and from the fruit, these very little organisms which we are considering this evening. We have either excluded them entirely or rendered them temporarily inactive by reducing the surrounding temperature. But let us open our fruit cans, or expose the meat during its voyage, for a few hours only, to the warm air and we find it rapidly un-

der-going change, on the one hand, fermentation, on the other, putrifaction, two phenomena invariably accompanied by the presence of bacteria and ceasing upon their abstraction.

We therefore find these minute organisms performing another grand service in nature's economy by completing the great circle of nutrition, causing by their presence, organic bodies to be hastily broken up into their inorganic elements, that they may once more begin the ever-lasting cycle; and were it not for bacteria, as Cohn puts it, "the material embodied in animals and plants of one generation, would, after their decease, remain bound, as are the chemical combinations in the rocks, new life could develop because there would be a lack of body material."

All bacteria are not ferment bacteria, neither do all attend putrefaction, but particular varieties invariable accompany each of these processes. We might continue with many interesting details of their minor beneficent qualities, as regards their relation to the litmus of the chemist or to the cheese and saurkraut of the German.

BACTERIA NOT THE *CONTAGIUM VIVUM*, BUT THE POSSIBLE CARRIERS OF SEPTIC MATTER.

But let us now take up that phase of their influence which is baneful, and which has only began to be appreciated within the last few years, chiefly through the labors of Sir Henry Holland, Pasteur, Klebs, Koch and Lister.

In speaking of the value of Pasteur's discoveries, Prof. Huxley says: "They fully balance the ransom of £200,000,000 paid by France to Germany, after the war of 1870-71." How, we shall notice more fully further on.

For some years past it has been found that certain forms of bacteria are constant attendants upon certain morbid processes both in man and animals. The question has naturally arisen, are they mere accompaniers of the diseased condition, or does it arise in consequence of their presence? In answer to this question much has been, and still may be said on both sides.

The great danger however, or new discoveries, is that on the one hand, half truths are accepted as whole ones, and on the other, dogged scepticism and ignorant ridicule meet the investigator at every step, his

best demonstrated facts being classed with those which he admits as merely probable. It has been thus with the advocates of the germ theory, and at the last International Medical convention in London, the father of antiseptic surgery—Lister—was obliged to protest against the extremes to which the advocates of the germ theory were carrying their ideas.

While we do find, as we have already remarked, particular varieties of bacteria attending certain diseases, and while they, in one sense, undoubtedly cause the disease, in another they do not, for we may introduce into the system the identical variety of bacteria, but which has been cultivated under different conditions and we find no evil effects following. The truth of the matter seems to be that bacteria act merely as the carriers of contagious matter. After reviewing a somewhat extended course of reading in relation to this subject, and taking into consideration many practical points gained in the pathological laboratories of Drs. Wood and Formad, who have been for some years past, studying the relation of bacteria to diphtheria, for the national board of health, I can but believe that it is not the action of the organisms themselves, but rather the morbid, septic material, with which they are saturated through their assimilation of certain noxious substances, which causes the pathological changes noted upon their introduction into the system—the disease varying with the peculiar conditions under which the germs have been cultivated. We know that plants and animals readily absorb materials in solutions of which they are immersed. It is easy to understand therefore, how bacteria, nurtured in solutions of unusually noxious materials, in organic substances undergoing rapid retrograde changes; and we have seen that it is their special duty to bring about just these changes—may, in their turn, become completely saturated with the poisonous gases and effluvia in which they are bathed.

Suppose that especially large quantities of these germs, poison saturated, are taken into the system, either by directly entering the circulation at abraded points, or by being brought into intimate relation with the blood by being inhaled into the lung. Is it any wonder that the blood in its turn should be contaminated by the infectious matter with which they are laden. No, this seems probable enough for while Tyndall and others have shown that multitudes of these germs are taken into the lungs at every inhalation, they have also shown that expired air is free from them, since they have been taken up by the minute ciliary brushes of the bronchi and bronchioles. Again it is a

settled fact that germs which are known to be of deadly potency, may be by cultivation in innocuous media, so relieved of their septic properties as to be introduced into the blood with impunity. Pasteur, the greatest of living microbists, in speaking of his experiments on chicken cholera,* says, "We may notice that it is possible to prepare cultures of varying degrees of virulence. One preparation will kill eight fowls out of ten, another five out of ten, another one out of ten, another none at all, although the microbe may still be cultivated * * the attenuated microbe having almost the bulk, the form, and the appearance of the most virulent microbes"—that is they have not lost a single optical characteristic; they are as true types of their species as ever. Thus he asks in another place,† "Does their shape and aspect change, while their virulence is changing in such a marked manner? I would not dare to affirm that there does not exist certain morphological relations, between the parasites and the various degrees of virulence which they show, but I must confess that it has not been possible for me to seize them. If any such relations should appear, they disappear to the eye, working through a miscroscope on account of the extreme minuteness of the virus, the cultivations seem to be the same for all degrees of virulence. If sometimes slight changes are seen, they seem to be entirely accidental, for in the next cultivation they either disappear or even sometimes inverse changes take place." We see that they have been washed of their poisonous material." It is the oxygen of the air which attenuates and extinguishes the virulence.‡ This accounts for the slow progress with which contagious diseases travel, and which has been offered as an argument against their pathological agency. It also accounts for the spontaneous cessation of epidemics.

Advantage has been taken of this possibility of attenuating their virulence to render through innoculation both men and animals proof against certain diseases; for having been rendered sufficiently ill by an attenuated virus, they will when innoculated with virulent virus suffer no evil effects, or only effects of a transient character. In this connection Sir James Paget speaking of Pasteur, says: "He has done for the lower animals, that which Jenner has done for the human race." We may find constantly in the human body bacteria of various kinds, and

* Address before the International Medical Congress, Aug. 8, '81.

† L. Pasteur "On the Attenuation of the Virus of Chicken Cholera." *Comptes-Rendus de Academy des Sciences*, Oct. 25, 1881.

‡ Pasteur, *loc. cit.*

yet we suffer no ill effects. Thus in the mouth have been found* *Micrococci*, *Bacillus subtilis*, *Bacterium termo*, *Sarcini Ventriculi*, *Spirochæte plicatilis*, *Leptothrix*, and a large form of *Spirillum*. The coating often noticed upon the tongue is largely made up of them. They exist in quantities upon the teeth, and are constantly found upon the mucous membranes of the entire respiratory and gastro-intestinal tract.

AGENCY OF DIFFERENT FORMS OF BACTERIA IN THE PRODUCTION OF VARIOUS DISEASES.

But let us for an instance take up our residence in the town of Ludington, on the east shore of Lake Michigan, a center of the lumber trade, producing annually enormous amounts of sawdust, part of the town being built upon a swamp which has been filled largely with the great staple of the place, i. e. sawdust. The drainage is so bad that in many places a hole dug a couple of feet in the ground soon fills with water, and only in a small percentage of the houses has any attempt been made to construct cellars. During 1880 and 1881 diphtheria appeared in the low region and spread with such thoroughness that it is said scarcely a child escaped an attack and about one-third of them died. ($33\frac{1}{3}$ per cent.). Dr. Formad who was sent to Ludington to make studies there in regard to the disease and with special reference to the micrococcus question has given the above description of the place.† Here we will be exposed to inoculation through inhalation and otherwise, by bacteria, which have been nurtured in rapidly fermenting and decaying organic matter, and with ninety-nine chances in one hundred that they will produce in us all the phenomena of diphtheria. Under the microscope however no difference can be noticed between these micrococci and those ordinarily found in the mouth, yet they have been distinguished as *micrococci diphtheritica*. To bring the matter to our own doors, let us glance at a number of cases of typhoid fever that only a few years since were all traced to the sufferers having drank from a certain well on the west side of the Genesee, strongly contaminated with sewage. Here the organisms instead of being inhaled and producing primarily a local irritation of the respiratory tract, were taken into the gastro intestinal canal, with the effect of producing a fever, the most characteristic features of which are its intestinal lesions. Now again we see their direct action, and still these same *bacilli*, while

* H. T. Batlin, Journal of the Royal Microscopical Society, 1879, p. 756. Beale, "Disease Germs," London, 1872.

† Supplement No. 7, *National Board of Health Bulletin*.

in no way differing structurally from *bacilli* which we may any of us cultivate and observe in putrefying solutions of animal matter, have been given the distinctive appellation of *Bacillus typhi abdominalis* (Klebs, Ebert). This I deem a partial mistake, they are distinct from ordinary *bacilli* in that they have become saturated with the more actively poisonous results of putrefaction, and have been taken into the body in large quantities, causing intense local symptoms at their first stopping point in the system: they being usually taken in fluids, which through the agency of the *cravate de suisse* pass at once to the small intestine without stopping in the stomach. And yet they are the same as the ordinary variety in all their microscopic characteristics and by proper culture may be rendered comparatively harmless. Let us therefore get a correct notion in regard to these agents of disease. In themselves innocuous; they may become under conditions in which poisonous products are being rapidly evolved, most dangerous by acting as carriers of the peculiar contagium in which they have been bathed and which may be the result of their assimilation of certain devitilized organic materials. I might easily enlarge upon this subject, but the examples I have given seem sufficient to illustrate the point, and we will now run as hastily as possible over the list of diseases in which bacteria are considered to act as causative agents. Beginning with those cases in which *Micrococci* or spherical bacteria are chiefly found, we will next glance at those in which the other forms, both rod and fibre-like, are the active causes.

In diphtheria we have already referred to the power of spherical bacteria—they are usually associated with the retrograde changes of vegetal matter and it is where this is especially active, that we find the disease of the greatest malignancy. Attacking that part of the body most exposed to inoculation by inhalation, namely the pharynx; and the mucous membrane of this region being thickly underlaid with lymphatics, their poisonous material is rapidly absorbed, and we have produced from the local irritation, excessive glandular secretion which on account of the close adherence of the squamous epithelum of the part can not be readily thrown off, and forms grayish white patches, which we call diphtheritic.

By auto-inoculation the disease may extend to the larynx and other adjacent parts, or it may originate in the larynx. The epithelium here being columnar ciliated, we obtain a membrane which is readily loosened, and we call it croupous, the membranes of true croup and

diphtheria, being identical in their origin and character, both being caused by the local inoculation of septic material carried by micrococci, and the severity of the constitutional symptoms in one and their mildness in the other, is readily explained when we understand thoroughly, the histology of the parts. The poisoned secretions are held down in the one case, by a firmly adherent squamous epithelium upon a region rich in lymphatics, while in the other, the secretions are more readily thrown off, as we have remarked, and if not thrown off, are not so fully absorbed on account of the poverty of the parts in lymphatics. Leaving diphtheria, we find spherical bacteria playing their part again in various inflammatory processes. Especially those which do not tend towards suppuration, as rheumatic affections and their sequalæ, affecting the heart, liver and kidney. In erysipelas, where the poison again shows its local irritating effect—this disease being regarded as an inflammation of the minutely distributed lymphatic vessels of the skin. In *pyæmia* and *septicæmia*, when the secretions are found crowded with them, in connection with other forms which Pasteur* regards as identical with his *Septic Vibrio*. So much having been said of these diseases during the late president's illness, I may be allowed to remark that these two diseases, together with that called sepsin poisoning, may be considered identical, differing only in the degree in which the putrid materials, carried by the inoculating bacteria, or without their aid, is absorbed. If sufficient be absorbed to excite destructive suppuration in parts to which it is carried by the circulation, it is considered to be *pyæmia*. If, however, we have no multiple metastatic abscessess, but all the other symptoms of putrid infection, we term the disease *septicæmia*, or sepsin poisoning. In epidemic puerpural fevers and in *Parotities epidemica* or mumps, we again see the power of these minute organisms as carriers of infecting material. Among the eruptive fevers, they act most powerfully. In scarlatina they are found in and upon the blood corpuscles. In measles they seem to carry some poison which is both abundant and powerful, for while one of the most common, it is one of the most contagious of diseases. But of this class of diseases we are, perhaps, most interested in *variola*, or small-pox. Here we have found the benefit of using these carriers of disease for its prevention. The *micrococci* which are found in a small-pox pustule are identical with those which we may any of us examine, by moistening in tepid water one of the points used in vaccination and placing the softened lymph under our glass ; and while in vac-

* "La Theorie des Germes," *Receuil de Med. Vet.*, 1878, p. 513.

cination we convey to the patient a mild form of the disease as found in animals, yet the bacteria of malignant small-pox differ in no way, except in the virulence of the poison which they convey.

Right here we might refer to the danger of conveying disease from cattle to man in using bovine virus for vaccination.* The danger of this is extremely slight when proper care is used in the selection of healthy animals. Only one disease has been known to have been communicated in this way, this resembling *herpes circinatus*, has occurred about fifty times out of the hundreds of thousands of cases of vaccination ; and every case was traced to virus obtained from irresponsible producers.

Of diseases which *might* be thus communicated the first is anthrax, or malignant pustule ; this is, however, so easily recognized in the animal, that there could be no possible danger of its being mistaken for a spontaneous cow-pox pustule. Tuberculosis might possibly be inoculated, but the possibility is extremely remote as the serum is innocuous, the tuberculous matter itself being requisite. Lastly, epizootic apthæ, or the foot and mouth disease, an acute infectious disorder of cattle, might be inoculated, but luckily it is almost entirely unknown in this country, although common in England. The last class of diseases in which we find the spherical bacteria is that of the infective tumors of tuberculosis, glanders, farcy and specific diseases. But as we shall see further on, *micrococci* may be the carriers of certain morbid agents in common with other forms of bacteria, and we shall refer to them in these relations.

But before leaving these little spherical germs we will, by referring to to them in connection with Pasteur's researches into the nature and cause of the great silk worm disease known as *Pebrine*, which decimates that insect species, as cholera slays its human thousands, discover "how a zoological study saved the commercial prosperity of France. Prior to Pasteur's researches, the silk worms died in multitudes from the mysterious epidemic, and blank ruin stared the silk growers and cultivators in the face. When, however, by careful study, Pasteur had made himself master of the situation and had found that a minute plant organism, propagating itself within the bodies of the silk worms and readily conveyed from one to the other, was the cause of the disorder, his countrymen fully realized the truth of the proverb that 'Knowledge is power,' and that to scientific research was due the sal-

* "Transmission of Bovine Diseases," in *Med. News* for May, 1882, p. 522–549.

vation of their commerce and the rescue of their happiness and prosperity."* Among animals the contagium of chicken cholera is also carried by a spherical bacterium, and by obtaining diluted cultures of this virus through exposure to the air for stated periods, Pasteur has been enabled to furnish a virus which protects fowls from the more malignant form of the disease, thus holding it under control in France.

Among other forms of bacteria associated with disease, we may mention the *Bacillus* of intestinal and eruptive Typhoid Fever, *Bacilli typhi abdominalis* (Klebs and Ebert), *Bacillus typhi exanthematic* (Klebs). Of Anthrax, *Bacillus Anthracis* (Cohn). Of Gastritis, *bacillaris*. Of Leprosy, *Baccillus leprosus* (Neisser). Of consumption, the newly discovered *Baccillus Tuberculosis* (Koch). All these among men; and of the Swine plague, *Bacillus Suis* among animals. Next the *Vibrions* of Cholera and Dysentery, *Vibrio rugula* (Pouchet). The Spirochæte of Relapsing fever, *Spirochaete Obermeiri* (Cohn)—which does not differ in form, size or movement from the *Spirochaete plicatilis* found during health in the mouth. Still another fibre-like form, the *Streptothrix Færsteri* (Cohn) is found in concretions within the lachrymal duct of man. In nearly every one of the above list of diseases, some form of the genus *Bacterium* has also been found, and in many cases *micrococci* coexist and are claimed by some as equally fruitful sources of the respective diseases. That this is the case in most instances I have little doubt. For it may be that while the contagia of disease is neither a soluble inorganic septic ferment, nor a specialized form of bioplasm, neither is it a parasitic organism, but rather a septic product of the assimilation by these organisms of morbid aliment. The same order of foods producing the same disease when ever the bacteria which have lived on them come in contact with mucous or other surfaces capable of rapid absorption, in sufficiently large quantities, producing thereby either local symptoms alone, or local and constitutional symptoms of varying gravity in proportion to the amount of septic matter absorbed and the tonicity of the patient, the peculiar disease being capable of transmission by means of any form of bacteria which may have been present and become saturated with its septic products.

* "Wilson's *Leisure Time Studies.*"